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BOILERS OLD AND NEW.

Paper presented to the Institution, London Section, 3rd October, 1929, by John K. Muir.

Historical.

MOST of you will already be familiar with the history of steam generation, but a brief reference to its beginnings may not be out of place. In the early part of the eighteenth century the application of the energy of steam for practical purposes attracted the attention of several experimenters amongst whom was Thomas Savery. His early attempts to raise water from coal mines by means of steam, although unsuccessful from a commercial point of view, were eminently successful from a scientific standpoint, as they showed that there were great possibilities, capable of development, in steam. Subsequent investigators, particularly Newcomen and Watt made further discoveries of its available properties. In these earliest experiments, which were conducted with a view to utilising steam in an engine, the boiler was usually an integral part of the engine. As engines developed and their size increased, it became necessary to make the boiler an independent vessel, and that stage was really the beginning of boilers as we have them to-day.

These early boilers were mostly used for supplying steam to pumping engines, and were only suitable for very low pressures, but about the beginning of the nineteenth century an engine was put to work with a steam pressure of forty pounds per square inch. Even after this demonstration of the practicability of using steam of higher pressure, progress was comparatively slow and no further advance was made for a considerable time.

In 1817 marine engines were still using steam at five pounds per square inch, which the literature of the period shows was considered to be about the maximum for safety, and no doubt with the materials available at that time, this was probably correct. Engineers then were of the opinion that there was no advantage to be gained by working at pressures more than six pounds above that of the atmosphere.

As the century advanced, and the experimenters who carried on the work commenced by the pioneers proved that increased pressures would be more economical, the designs of engines and boilers were advanced a stage further. Engines using steam at 100 and 150 pounds per square inch soon became common. The advance in the use of wrought iron and mild steel in place of cast iron helped to make these higher pressures possible, and it soon became regular practice to have engines and boilers working at 200 pounds per square inch. Up to a few years ago 250 pounds was considered quite a high pressure.

Boiler Types.

It is not necessary to refer further to the early type of boilers which were the steps in the evolutionary process of which modern boilers are the result. We shall look, however, for a few moments at the different types in use at the present day.

One of the most common types of boiler is the Lancashire, and there are probably more of these in use in this country to-day than any other type.

A Lancashire boiler is made up of a cylindrical shell having two furnace tubes passing through it. The gases pass through these tubes and find their way to the chimney by means of flues built round the outside of the shell. Boilers of this type have proved very serviceable for certain conditions and still find many advocates. They have a fairly large steam space and are, therefore, suitable for process work in which large quantities of steam are necessary at irregular intervals. Owing to the large dimensions of the pressure parts, they are limited to moderate pressures, and about 250 pounds per square inch would appear to be the maximum pressure for which they can be used.

The Scotch marine boiler is a favourite type in the Mercantile Marine. It has also given excellent service in the Navy. The advent of high pressure steam has, however, considerably reduced its

sphere of usefulness, as its design is such as to make it unsuitable for very high pressures. In this connection it may be of interest to know that for a pressure of 600 pounds a 16-foot Scotch boiler would require to have a shell about 5½-inches thick, and the difficulty of satisfactorily staying the large flat ends rules this form of boiler out altogether for high pressure steam. Its abolition, however, will not take place until the economic advantages of high pressures have been clearly demonstrated to ship owners, as it has proved a most reliable boiler.

There are various other types of steam generators, all of which find uses in the many industries of the world, but the most commonly used boiler in modern practice at the present time is the water tube type. As its name implies, the essential feature of this type is that the heating surface, or to state it more clearly, that part of the boiler which is in contact with the combustion gases, is composed entirely of tubes through which the water circulates.

Numerous designs of water tube boilers have been evolved, some have the tubes connected direct to cylindrical shells and others have them expanded into water boxes or headers. One common feature is that those parts which have to withstand the steam pressure are of small dimensions and are consequently admirably suited for the increasing steam pressures which are now becoming common.

Turbines.

Before briefly considering the modern boiler, it might be advisable to think for a moment of the uses to which steam is being put at the present time.

There is undoubtedly a very large amount of steam used throughout the world in carrying out the various processes connected with industry of every kind, and that demand will continue until new processes are evolved. The greatest steam demand, however, will in the future be for electrical generating plant, the development of which is going rapidly ahead. The steam turbine has revolutionised steam engineering as it has made it possible to use steam pressures and temperatures far in excess of those which were considered possible not so many years ago.

It has now been proved beyond the shadow of a doubt that high steam pressures and high temperatures give increased efficiencies in steam turbines. Such being the case, the tendency at present is to use steam round about 600 pounds per square inch and with a final temperature of about 800° Fah. There are boilers steaming at present with even higher pressures than this. What will ultimately prove to be the most efficient combination of pressure and temperature will only be determined after results have been obtained from some of the plants at present under construction or about to be put into commission. The remarkable increase in the size

of electrical generators which has taken place in the last few years has resulted in a corresponding increase in the size of steam generators. Up to a few years ago, a 5,000 k.w. electrical generating unit was considered comparatively large, but to-day there is a 200,000 k.w. unit being installed in the State Line Station in America.

Modern Boilers.

To meet the enormous steam requirements of these large electrical machines, boilers are being called for with increased evaporations. Steam generators capable of evaporating 100,000 pounds of water per hour are now quite common, and units for 500,000 and up to 800,000 pounds per hour are now being considered. Boiler designers and manufacturers are now faced with entirely new problems both by reason of the larger units, and the higher pressures and temperatures which increased efficiency demands.

A boiler generating three quarters of a million pounds of water per hour cannot be thrown out of commission suddenly without seriously upsetting the running of a power station. Consequently, greater attention has to be given to the constructional details to prevent shut downs from taking place at inconvenient times.

A modern steam generating unit with its necessary auxiliaries has become a rather complicated part of power station equipment, comprising as it does, boiler, stoker, superheater, economiser, air heater, forced and induced draught fans and dust collectors. Time does not permit of an extended examination of these various sections of a steam generating unit, but a passing reference to their salient features may be of interest.

Boilers.

The higher pressures have not caused any insuperable difficulties so far as those pressure parts which are only subjected to water pressure or saturated steam are concerned. The scantlings of these parts have, of course, had to be increased to take charge of the increase in the pressure, and in some instances it has been necessary to use solid forged drums in place of the riveted type. Drums having the longitudinal seams welded have found favour on the continent, but they are not used in this country.

Superheaters.

The design of superheater parts calls for special consideration, as the material, in addition to having to withstand the stresses set up by pressure, has also to be suitable to resist the high temperature. When it is realised that engineers now ask for a final steam temperature of 450° Centigrade, it will be understood that the point is being approached where ordinary mild steel cannot be used. The yield point of mild steel at 90° Centigrade is about sixteen tons per square inch, but at 450° Centigrade it is only about

five tons per square inch. The value decreases very rapidly above the last mentioned temperature. Hitherto accepted values for the strength of materials are now subject to suspicion as certain metals which, though quite suitable under normal temperatures for short periods of time, show signs of deterioration when subjected to moderate temperatures and stress for long periods. This condition becomes accentuated when dealing with higher temperatures. Fortunately, metallurgists are well aware of the limitations of ordinary materials, and experiments are being conducted in all the principal engineering countries at the present time with a view to providing material which will be suitable for the extreme conditions now to be met.

Mountings.

High pressures and temperatures have also had an effect on the design of boiler mountings, and the manufacturers of these have had to watch the designs carefully in view of the new conditions. At the present time, some of the special metals which are suitable for use with steam at high temperature are practically prohibitive in price, and it is sometimes difficult to get those who prepare specifications to realise the limiting factors which have a bearing on the design. It is very true that " necessity is the mother of invention " and the demand for high temperature resisting materials will undoubtedly spur on inventors to produce material which will be suitable for modern conditions and at the same time be reasonable in price.

Furnaces.

There is no part of a steam generating unit which has undergone so much change in recent years as the furnace. The number of mechanical stokers now on the market is very large, and the types are so varied as to suit all the requirements of even the most fastidious engineer. This is a subject in itself and it would be useless to attempt to describe any of the various types in detail. They are all made suitable for use with preheated air under balanced draught conditions. This condition is one of the most frequently met with in modern plants. It has now been realised that an increased volume in the furnace improves the combustion conditions to a great extent and furnaces have, therefore, been heightened. The use of hot air has given rise to trouble with the refractory lining of the furnace. As, however, its use considerably improves combustion conditions it has been found necessary, rather than discontinue its use, to overcome the refractory difficulties in another manner. This has been achieved by the introduction of cooling tubes in the furnace walls and stoker arches. In some furnaces these tubes are totally exposed and in others the tubes have a thin lining of refractory between them and the furnace. Another type which

is finding considerable favour has a metal block attached to the tube, this block may be either metal throughout or have a refractory facing. The cooling of the furnace walls has resulted in a great reduction in the brickwork maintenance costs, and what is of more importance to a power station engineer, has prevented boilers from being kept out of commission for lengthy periods. It has also enabled the stokers to be worked at a much greater combustion rate. The initial cost of a water-cooled furnace is naturally higher than that of a furnace of the brick-lined type, but it will be found that a water-cooled furnace will more than pay for its extra cost by the advantages which it gives.

Economisers.

Since the introduction of feed water heaters which are heated by steam bled from the turbines, the temperature of the feed water leaving the heaters is so high that it is often possible to eliminate economisers altogether and in many plants air heaters only are being provided. As there must be a sufficient margin between the saturation temperature of the steam and that of the entering feed water there is, therefore, a maximum temperature above which it is not desirable to heat the feed water. There are what are known as steaming economisers which are connected direct to the boiler and really form an integral part of it, but these have not been adopted to any great extent in this country.

Where no air heaters are provided, economisers are necessary if a reasonable efficiency is to be obtained. There have been developments in this part of the unit as in other parts, and careful consideration is given to design in order to take full advantage of the heat in the gases. On some types, gilled tubes which have a very large surface per unit length are used, and there are also economisers in which the increased transmission is obtained by causing the gases to pass between the tubes at a fairly high speed. This, of course, increases the draught loss through the economiser, and provision has to be made in the fans for this increased resistance. It is often stated that mild steel economisers, which are composed entirely of mild steel tubes and headers, are not suitable owing to corrosion difficulties, but in all modern plants special care is now taken to remove the corrosive elements from the water, otherwise, not only will the economiser be affected, but the boiler pressure parts also. This matter needs more attention now than ever it did, in view of the increasing pressures.

Air Heaters.

The use of air heaters has considerably extended in recent years and in almost every specification for new plant manufacturers are asked to tender for a combination of economiser and air heater, and in some instances for air heaters only. Under certain conditions

it is possible to design a plant with an air heater only, but to reduce the gases to the final temperature necessary to give the high efficiences required, it is often found necessary to introduce an economiser in addition to the air heater, otherwise the proportions of the latter become excessive.

Like other parts of the unit, air heaters are varied in design. There are three distinct types which are worth our attention. The first design to which I would refer consists of a series of thin plates set on edge radially from a centre like the spokes of a wheel. The plates are pitched closely together and are attached to each other so as to make a wheel formation. The gases pass up between the plates and give up part of their heat to them. The wheel meanwhile is rotating slowly, and the plates which have absorbed the heat pass from the gases to the air section of the heater where the air in passing through this section cools them and is consequently raised in temperature. As the rotation is continued, the cooled plates pass round to the gas section again, the operation of alternate heating and cooling of the plates being a continuous one. This is claimed to be a very effective type of heater, but its design would lead one to think that there would be difficulties encountered in cleaning the spaces between the plates.

The second type is known as a plate air heater. It has no moving parts and is simply a series of very narrow compartments composed of thin plates. The gases pass up through alternate compartments and the air passes down the others. The spaces between the plates are very small, and as the plates are thin, there is a fairly good transmission of heat from the gases to the air. This design, like the first mentioned, is very compact and a large heating surface can be got into a very limited space.

The tubular type of heater is well known. It is the same in principle as the smoke tube boiler, the gases passing through the tubes and the medium to be heated round the tubes. The earlier designs of this type had comparatively short tubes and were baffled so as to make the air follow a tortuous path, but they are now made with tubes up to 36 feet in length with a single air pass, the area of the passages being so arranged as to give the maximum transmission without unduly increasing the draught loss either on the air or gas side. Good results have been obtained from the tubular type and it is easy to keep clean. It is, however, somewhat bulkier than the other types, and is more suitable for a unit where the space available is ample.

Draught Plant.

The resistance to the passage of the gases through a unit composed of boiler, economiser and air heater has made it necessary to instal fans of ample capacity, and these are very important parts of the auxiliary equipment.

The evaporation in modern boilers is practically dependent on the proper functioning of the induced draught fan. Those of you who are not familiar with power station design will probably have remarked on the comparatively low chimneys now in use. There is a tendency, particularly in the States, to return to high chimneys, but this is because of the grit nuisance. As you know, the gases carry with them in suspension in their passage through the boiler very considerable quantities of grit. In a low rated boiler with natural draught, these grits are deposited in the various passages of the boiler, but on highly rated boilers with a high suction draught, the grit is drawn right through to the chimney. When the boilers are situated in close proximity to cities where pollution of the atmosphere is now having the attention of the local authorities, or close to industrial establishments where grit would affect manufacturing processes, it is necessary to have grit arresters. Some of these depend on centrifugal action and are so constructed as to cause the gases to follow a circular path at a high speed. Due to centrifugal action, the grit is thrown to the outer edge of this path and is trapped at points in it. Another type of arrester depends on a fine water spray for removing the suspended material from the gases. There is also an electrical type of grit arrester which has been used in America. In this type the gases pass between a series of hanging rods which are highly charged with electricity. The grits are attracted to these rods and are deposited into a hopper. This type is very expensive.

All the types mentioned have still to be improved as the problem has not by any means been solved.

Time does not permit more than a passing reference to a few other features of boiler room equipment. In countries where oil is plentiful and cheap great use is made of it as a fuel. It has many advantages over coal: handling, storage, and combustion regulation, to mention but a few. First cost, however, rules it out as a fuel in this country.

Pulverised coal is now being used to a much greater extent in boiler furnaces. The results of its use are being carefully watched by engineers, as all concerned with electrical power generation are intent on producing power by the most efficient and economical means possible.

Waste gases which formerly were discharged to the atmosphere are now used to fire boilers. These gases, the product of coke ovens, blast furnaces and refuse destructors, all contain a considerable proportion of combustible, and their use results in large economies in certain industries.

The foregoing is what might be termed a free-hand sketch of a modern boiler unit. The film will show the construction in detail. This film is typical of the methods followed in the Babcock and Wilcox organisation, and while the methods may vary slightly in

different works, they are generally on similar lines to those shown.

(*A cinematograph film illustrating the principles embodied in the Babcock and Wilcox boiler, and its action during operation, together with details of construction and manufacture, was then shown*).

Discussion.

MR. R. H. HUTCHINSON, who opened the discussion, said that the films just exhibited had been one of the most uplifting sights that he, as a production engineer, had seen for many a long day. They illustrated a magnificent example of British engineering production and demonstrated the production of large units in relatively small numbers in contrast to the production of an enormous number of small units which were regarded by so many people as engineering production. The means which had been devised, as shown in the films, for handling such large things as the parts of boilers were a revelation, and Messrs. Babcock and Wilcox were to be congratulated upon showing what production engineering really meant. The lecture had served to emphasise the President's remark that engineering production was not merely the production of motor cars, and no better example of the truth of that could have been given to them than what was being done by Messrs. Babcock and Wilcox.

MR. DORMER said that some years ago he had had the pleasure of a visit to the Renfrew works of Messrs. Babcock and Wilcox, but he was not able to see the manufacture of the header. He presumed it was more or less a secret. It had been interesting to see on the film how the tubes were put in, but it was not quite so easy to take them out on board ship.

MR. A. J. HANCOCK, PRESIDENT, LONDON SECTION, who occupied the chair, asked if Mr. Muir could say something about the purification of the feed water. He believed an electric process had been evolved which had the effect of removing or precipitating the sediment in the water.

MR. MUIR said he could not answer this question in detail. There was a chemist attached to the staff, and he advised on such matters. He was not familiar with the apparatus mentioned by the President, but he knew the subject was giving a great deal of concern. There was a school of thought which endeavoured to make out that by treating the feed water, caustic embrittlement was set up in the pressure parts of the boiler and particularly in the steam drum, and numerous insurance companies had discovered that this caustic embrittlement was the cause of trouble, and that the plates deteriorated much more quickly by the use of treated water than if the water was left untreated. Therefore, the question of treating the feed water in the best manner was one of very great importance, more particularly in connection with rivetted drums, in which there

was a series of small parts which were liable to be attacked. It was stated that by treating the water with chemicals—as was the case at present—the chemicals became lodged in the small crevices and in time caused trouble with the plates. With regard to Mr. Dormer's question concerning the header, whilst he was not permitted to give details of the construction, it might be interesting to state that the headers were solid drawn from the billet something like a solid drawn tube. The machinery by which they were made had been designed and manufactured at Renfrew.

MR. SUMNER asked for some further information as to the methods adopted for handling the heavy parts involved in the manufacture of boilers.

MR. MUIR replied that the heaviest parts that had to be handled were the drums, and some of them weighed thirty or forty tons. The shops were equipped with a number of overhead cranes capable of lifting forty tons in some, but in some instances it was necessary to use two cranes for one drum. There were also small runways with cantilever cranes for handling small headers in the shops, and electric trucks for transport of smaller parts. Otherwise, the handling equipment was very much the same as in any ordinary engineering shop.

A speaker enquired how long electric trucks had been employed at the B. and W. works for conveying billets to the presses. As a boy he remembered seeing in the ironworks in the Smethwick district the billets being towed along in big boxes by the men, and it was interesting to him to see on the film that electrically driven trucks were used for this purpose, which was a distinct improvement on the old days.

MR. MUIR said he could not give the exact date when these electric trucks were introduced. They were more or less of fairly recent development, however.

A SPEAKER asked what means were provided of knowing when the tubes were expanded into the header sufficiently.

MR. MUIR said there were gauges. The tube was expanded about one-sixteenth inch outside the header and there was a gauge reading which must not be exceeded. When the tube was up to the gauge it was sufficiently expanded to withstand the pressure.

MR. R. H. HUTCHINSON, referring to the remark made by Mr. Muir during his lecture that certain installations were being built for very high steam pressures and temperatures, asked if it were possible, without giving away secrets, to say the pressure for which these plants were being built.

MR. MUIR said there was one boiler in America working at 1,500 pounds per square inch pressure, with a final temperature of 842° Fah. or 450° Centigrade. Many boilers were working at about 700 lbs. and the final temperature at the present moment in the majority of cases was about 600 to 700° Fah. A boiler was going

into service in Bradford shortly which would work at 1,200 pounds pressure and 842° Fah. It was not, however, easy at the moment to say what would be the most efficient combination of pressure and temperature. The pioneers of high pressures favoured higher pressures, but at present there was nothing but theory to go upon. There were so many unknowns that it would be necessary to have a good deal of practical experience before a definite opinion could be expressed. At present there were installations working between 650 and 1,500 pounds per square inch, and he rather believed that the limit for some time would be between 600 and 800 pounds per square inch, leaving the extreme pressures for people who were prepared to put down plant and carry out what was more or less an experiment.

A SPEAKER asked how the rivets were supported from the back whilst they were being riveted from the front. Was it necessary for someone to have to crawl into the drum and hold a dolly?

MR. MUIR said it was necessary for a man to be inside the shell, which was dropped exactly into position beside the rivetter on the outside, and the man inside put the rivet through from the inside. It was not necessary, however, for the man inside to hold the rivet whilst it was being operated on. This was done by the head on which the shell was placed for riveting. In high pressure work the rivet could be worked from the outside, but with low pressure work it was desirable to have the head of the rivet inside, and it was for this reason that it was necessary to have a man or a boy inside to pass the rivet through. The welder did the rest.

MR. BEALE asked for some information about the materials of construction and also the methods of renovating tools.

MR. MUIR replied that perhaps the press for the drum head was the best illustration he could take. The dies for that forging work were detachable for pressing out different diameter drums, but the aim was to make as many of the same diameter at the same time in order to avoid removing the dies, because the cost of doing this in time and expense was considerable. The dies were robust in construction and were made of cast steel with the usual tensile qualities. They had renewable parts, so that the wearing portion could be renewed whilst the main portion of the die remained. They were also made detachable to suit different thickness of plate. The life of the hydraulic presses was considerable, because they were of very robust construction, and although they appeared to suffer from very severe treatment, the parts were made correspondingly strong. In the case of the bending presses for plates, the working parts were made of cast steel, and there was a considerable amount of cast steel used in the body of the machines. The pressures used were from one to two tons per square inch. He could not give details of the life of the machines, but there was no hesitation in scrapping any machine when it ceased to be efficient. The

machines for the manhole fittings were semi-automatic, and one man could look after three or four machines. The biggest expense was the cutters, which were like milling cutters, and could machine two faces at the same time. The machining and finishing was practically completed in one operation. There was a tool room to which the tools were returned for re-sharpening. A man did not need to waste any time looking after his tools. He simply took a cutter out of the machine and put in a new one. The drilling machines were very much the same as drilling machines in any other branch of engineering.

MR. GERARD SMITH said that whilst the author had dealt entirely with stationary boilers, he would like to know whether locomotive boiler practice had stood still so far as design was concerned, and if there were insuperable difficulties in the application of mechanical stokers to the locomotive boiler.

MR. MUIR replied that although he had no personal knowledge on the matter he did not think locomotive boiler design was at a standstill. The size of these boilers had gradually increased, and the introduction of superheated steam was comparatively recent. Oil firing was being fitted to some extent, although not to a very great extent, but he did not know of any example of mechanical stoking on locomotive boilers. At the same time, he would not be surprised to see powdered fuel adopted. It had been adopted on the Continent in very up-to-date work, but powdered fuel for boilers generally was only in its infancy.

MR. GERARD SMITH said there seemed to be no reason why the powdered fuel should not be carried in a tender and the ashes dropped over the back, as in stationary boiler work. He was wondering why it had not been done.

MR. MUIR replied that the probability is that in the course of a very few years there will be no steam locomotives at all, as all our railways will by then be electrified.

THE PRESIDENT said he was certain nobody could have listened to Mr. Muir and seen his films without appreciating the truth of the remark made by Mr. Hutchinson as to the importance of such things as boilers in facilitating the processes for various other forms of production. Mr. Muir apparently was still able to appreciate that there was romance in boiler manufacture, although it had long since ceased to be a mystery to him. He would be expressing the feelings of all present in proposing a hearty vote of thanks to Mr. Muir for his kindness in giving his lecture and showing the films, as well as answering the many questions that had been put to him.

The vote of thanks was carried with acclamation.

MR. MUIR acknowledging the vote of thanks, said that whilst he had dealt with the boiler industry, he believed a good many of those present were interested in the Diesel engine. It might,

therefore, have been a point of special interest to them to see that the boiler industry was not standing still, but was doing its best to come up to the high efficiency of the Diesel engine. Nothing had been said about the application of boilers to ships but that was a matter of great importance. There had been a marked advance in the efficiency of boiler and turbine machinery on board ship, and the boiler makers and turbine makers had great hopes of being able to oust the Diesel engine from ships in a very short time.

SIXTH ANNUAL DINNER, LONDON, 19th October, 1929

By kind permission of "Machinery."

SIXTH ANNUAL DINNER.

THE sixth annual dinner was held at the Restaurant Frascati, Oxford Street, London, on Saturday, 19th October, 1929, Sir Alfred Herbert, K.B.E. (President) in the chair. After the toast of "The King" had been honoured, Sir Herbert Austin, K.B.E., proposed the toast of "The Institution." He said that when he first came into touch with the Institution of Production Engineers he thought it was simply another Institution, and looking at the matter from a purely practical point of view, it seemed to him that there were more Institutions than could really be managed. That point had been forced upon his attention when the Institute of Works and Costs Accountants had been formed. He had taken a very definite interest in that because several of those who had started that Institute, including Mr. Perry-Keene, the Costs Accountant at the Austin works, had argued as to the necessity for a new body owing to the fact that the two institutes of accountants were very reserved in their membership, and it was very difficult for anybody to enter their ranks. The two existing accountants organisations made it necessary, in order to qualify for membership, for a man to serve a certain number of years in an accountant's office and go through a regular course. He did not suggest that that was not a good scheme, probably it was because it put upon the man a hall-mark of accountancy. When the Institute of Works and Cost Accountants was started, he himself was very interested because for many years he had been endeavouring to arrive at a scheme in the works with which he was concerned, by which the cost accountants office and the cost accountant in the works would be able to control the layout on which the programme for the year was carried out. Some twenty-five or thirty years ago that was called cost control, and in those early days, instead of the operations being controlled by the drawing office or from the manager's office, they were controlled by the cost office. Those engaged in the cost office, of course, did not go into the works and tell the superintendent or the foremen how they were to do their jobs and whether they were doing it right or wrong. They simply handed to the superintendent of the shop a record of the previous week's working, and if that record was below the programme figures, obviously there would be an incentive to the superintendent to get up to the programme figures. At any rate, he knew where he was and he would be expected in the following week or period to do something in the way of recovery. That was actually started thirty years ago when he was with the Wolseley Company, which was part of the Vickers' organisation at the time when it was in the hey-day of its prosperity. When he had drawn the

attention of the Vickers' organisation in Sheffield and other centres to what was being done at the Wolseley works, he was received with a great deal of amusement. The Wolseley works were treated as the sort of small boy in the organisation, but he remembered quite well when they came to the end of the financial year how pleased they were that there was a balance on the right side, because in those days there were not millions made in profits out of the motor-car industry. The Secretary of Vickers was a very pompous man and a very able man, but the only remark he could make was, "I do not see that you have pulled up any trees." That was the attitude. Several times since the formation of the Institute of Works and Cost Accountants he had tried to get it recognised or sympathetically considered by the two accountants' organisations, but he had been turned down on each occasion. These men were not considered inside the pale, yet every production engineer knew what an important bearing cost accountancy had upon production and the difficulties that were introduced if the figures were not up-to-date. The Institute of Works and Cost Accountants had had a very rough time, and if it had not been for a few enthusiasts it would have gone under. It did not get any sympathy from the recognised accountancy organisation, but it had, nevertheless, made good. There was no manufacturing business to-day which was not aided very largely by a successful works accountants' office, and he did not think it was possible for any really competitive production to take place with success without the assistance of such a department.

The Institution of Production Engineers was probably one of the youngest institutions in the country dealing with practical matters. He was told that there was a membership of over three hundred and that there had been an increase of 20 per cent. during the past four or five months. That was all in the right direction but there was still a doubt in his mind as to whether the Institution should remain a separate Institution or should be amalgamated with, or come under the wing of, one of the older and bigger Institutions, such as the Institution of Mechanical Engineers. He did not wish to damp the ardour of those who were working for the success of the Institution. That would be unfair and was not in his mind, because he was perfectly certain that if there were not work of a practical nature to be done the Institution could not have existed and would not have prospered. He gathered that a very interesting series of papers had been and were being read and discussed, and he had been informed that the work the Institution of Production Engineers was doing would hardly be practicable for the other Institutions to handle. He could only say that the special knowledge of the production engineer in a factory dealing with quantity production was becoming more and more important and, indeed, was becoming the most important part of the business

outside the original design. At the same time, there was no doubt that the commercial side of engineering was the one that had been most neglected in the past decade. In the past, the engineer had been rather associated with trying to deal with technical subjects, but it would generally be agreed that on the commercial side there was still a large amount to be done before it was as satisfactory as the technical side. It was that side of the engineer's training that really required more attention to-day than the technical.

No doubt there was a great deal of work for the Institution of Production Engineers to do, properly organised and handled by competent officers. He had been informed that the Institution had recently appointed a full-time general secretary, and that was certainly a step in the right direction. But, even so, the success of such an Institution depended entirely upon the interest taken by the members. There must be full attendances at the meetings and discussions, and members must not be content to stay away and read the papers and discussions in the Proceedings. It was necessary for everybody to attend the meetings and to get up and say something. In his opinion, everybody present should be expected to speak, and if the Institution were run on those lines, then he was certain it would be a valuable help and he would like to see it flourish because, as he had already said, the production side was becoming increasingly important. He hoped the Institution would look after the commercial side as well as the technical side. He had known cases where works were being very successfully managed by men at the head of the production department who were not engineers. Personally, he did not believe that was the right thing. He did not believe that anybody connected with a works in any department ought to be merely a commercial man. As a matter of fact he was strongly of the opinion that the sales side of a business, when they were handling such things as a lathe or a planer, a motor car or even a pair of boots—if they were handling things that had to function—should be composed of men with practical knowledge of the things they were selling.

Mr. J. A. Hannay (Chairman of Council) who replied, said he believed Sir Herbert Austin had deliberately put them on their mettle by speaking in the manner he had done. So far as the Institution and its work was concerned, it had in the past been seriously handicapped by the absence of a permanent secretary, but he was quite convinced that with the appointment of a full-time general secretary the Institution would now go forward and flourish. The Institution at present had three sections, viz., London, Birmingham and Coventry, and with the election of Mr. A. J. Hancock as President of the London Section he believed London would make considerable progress. He understood that Mr. Lloyd was to be the new President of the Coventry Section. Anything that came from the firm of Alfred Herbert was bound to be good. In Birm-

ingham they were going to be presided over by Mr. Groocock, works manager of the B.T.H. Company, who was a thoroughly practical man, and there was every prospect that Birmingham had a good season in front of it. He congratulated the new general secretary upon the printing of the complete programme of the various sections for the whole session. In previous years the sections announced their own programmes from time to time, and this innovation was an indication of the new activities of the Institution. Incidentally, it might interest Sir Herbert Austin to know that there was to be a lecture on costing during the session. Birmingham was the last section to be formed, two and a half years ago, and it now had over a hundred members. At some of the meetings the attendances reached 150 or 200, and he could speak from personal experience of the enthusiasm that was being shown in the Birmingham district for the work of the Institution. Owing to the success of the existing sections, endeavours were being made to start sections in other large centres. It was hoped to hold a meeting in Manchester in January to consider the question of forming a section there, and the point he wished to emphasise was that the Institution desired to have as members men who were willing to work hard in its interests. As to the position of the Institution in relation to the older organisations, he had the greatest respect for the older institutions, such as the Institution of Mechanical Engineers, and he would not interfere with the technical engineer pure and simple, but generally speaking the technical engineer was too much wrapped up in pure engineering and did not get a move on. He wanted to know how this and that worked instead of getting the thing made. Whilst there might be those who thought the Institution of Production Engineers was not justified as a separate institution, his own view was that the older institutions had had their day. The country had been tremendously handicapped since the war, and somebody had to get a move on as regards production. He believed it was only through the practical production engineer that this could be done, and costs so reduced as to enable us to sell much more cheaply and get back some of the trade that had been lost. If we could only sell cheaply enough we could get the trade. Something had to be done. The country had to be wakened up and production increased, and from that point of view, seeing that the older institutions had had their chance, he contended that the Institution of Production Engineers was fully justified as an organisation devoting its time specifically to production problems. At the same time, we must not be led away with the idea that the production engineer is everything. The secret of all success in production work was to have good design. It was not for the production engineer to think he could alter the design to suit himself; it was for him to carry out whatever design was put before him.

MR. R. H. HUTCHINSON (Past President), proposing "Our Guests," coupled the toast with the name of Mr. A. E. Evans (President of the Association of Teachers in Technical Institutions) and said that that in itself was an indication of the expanding scope of the work of the Institution. The Council realised the great importance of training the young engineer to carry on the great work of production engineering, and with that in view they were developing the examination side. A syllabus was being drawn up for the graduate class, and eventually that would be extended to every class of membership of the Institution. In this it was hoped to have the co-operation and guiding hand of the educational authorities of the country, and of the older institutions governing education, for to attempt to go forward without that would be unwise. Something had been said as to why the Institution was not under the wing of the Institution of Mechanical Engineers or even part of that Institution. There was, however, a great difference between the work of the Institution of Mechanical Engineers and the Institution of Production Engineers. A great deal would have to be done in the matter of training the young production engineer to fill the tremendous field of control available in engineering production, and it was here that the Institution of Production Engineers could do very important work. Sir Herbert Austin had mentioned that a man who produced boots was just as much a production man as one who produced motor cars or anything else. That was perfectly true, and as long as the man was producing boots by engineering methods, he was a production engineer and eligible for membership of the Institution of Production Engineers. Sir Herbert Austin had also mentioned mass production, but he himself would like to emphasise the fact that the production engineer was not necessarily a man who was engaged on mass production. The Institution was not an Institution of mass production engineers or motor-car engineers or sewing-machine engineers. It was an Institution dealing with all the problems of production in all its forms and, after all, the fundamental principles of production were the same whether they were producing large turbine sets or battleships or 2,000 motor cars or 20,000 sewing machines. The Institution was endeavouring to deal with all the problems of production, and if that could be brought home to the leaders of industry in the engineering industry in the country, there would be little doubt that the Institution would in time become the fourth largest engineering institution in the country.

MR. A. E. EVANS, replying to the toast, said he did not claim to be a production engineer, nor did he even aspire to be an engineer. He was merely a dabbler in pure science, who in his spare time professed to be President of the Association of Teachers in Technical Institutions. Mention had been made of methods of selling but he would like to say that in investigating salesmanship we must

not lose sight of the importance of efficient production engineering, because salesmanship would be ever so much easier if the article produced fulfilled the needs of the consumer. He felt, therefore, that it was as important to investigate new methods of production as it was to study salesmanship, because the one helped the other along so much. One of the reasons why he was pleased to be present at the dinner was that the Institution was preparing an examination scheme which was being considered in conjunction with his Association. That scheme would be examined in all its details. At the same time, his view and the view of most teachers in technical schools was that any educational scheme to be of any use for industry must be one that took into account both the practical side and the theoretical side. The great snag in drawing up examination schemes was that they were too often of a narrow and parochial nature, and he would go farther and say that schemes of a local character would act detrimentally to the individual because any certificate to be effective must be acceptable in all parts of the country. Therefore, he was in favour of a national certificate scheme, and he hoped it would be possible for the engineering institutions on the one hand and the teachers in technical schools on the other to draw up a scheme which would be valid throughout the country. He believed the Institution of Production Engineers was working along the right lines by acting in this matter with other people and in working for what he had termed a national certificate.

Mr. Tom Thornycroft (President Elect) proposed the toast of "The President" and referred to Sir Alfred Herbert as a real human man and one who thoroughly enjoyed any work that he put his hand to. That was an excellent point, because it was essential to enjoy work if it were to be done well. The work the President had done for the Institution had been of the greatest possible value, and he asked those present to honour the toast enthusiastically.

The President acknowledging the toast said that the very interesting question had been put by Sir Herbert Austin as to whether the separate existence of the Institution was justified. He was willing at once to admit that one of the weaknesses of the British nation was to found institutions. He did think, however, that the Institution over which he had had the honour to preside for two years had justified to the full its free and separate existence. Everybody had the greatest respect for the old and learned societies, but they did not get down to the job in quite the same way that the Institution of Production Engineers did. The older institutions dealt with very important matters, but perhaps a little bit in the clouds. The production engineers were the boys who really got on with the job, and this reminded him of a limerick which might be old but still had a lesson :

There was a young lady of York
Who swallowed a wine bottle cork ;
In this state of emergence
They sent for three surgeons,
But the cook got it out with a fork !

Production engineers, said Sir Alfred, are the boys who get it out with a fork, and that was the difference between the Institution of Production Engineers and some of the older engineering institutions. In conclusion, he congratulated Mr. Tom Thornycroft on his election as President of the Institution, and at the same time congratulated the Institution upon having secured as its President an eminent engineer, under whose guidance the work of the Institution should go ahead by leaps and bounds. He wished Mr. Tom Thornycroft every success during his term of office. He also congratulated the Institution upon appointing a full-time general Secretary in Mr. Hazleton who, by his past record and present performance, could be trusted to do his duty, and keep the ball rolling and the Institution going along as it should. He wished Mr. Hazleton every success in his work.

MR. HAZLETON acknowledged the good wishes of the President.

Very pleasant entertainment was provided by the Wranglers (Messrs. Wilson James and Algernon More) in humour and harmony, and Mr. Wilfred Huggins, card charmer.

ANNUAL GENERAL MEETING.

London, 7th November, 1929.

THE Annual General Meeting of the Institution was held in the Council Room of the Society of Motor Manufacturers and Traders, 83, Pall Mall, London, on Thursday, November 7, 1929, Mr. J. A. Hannay (Chairman of Council) presiding.

The minutes of the previous Annual General Meeting were read and confirmed.

The GENERAL SECRETARY announced the receipt of a letter from Sir Alfred Herbert, the retiring President, regretting his inability to attend the meeting.

The result of the elections to the Council were announced and the Auditors for the coming year elected.

The CHAIRMAN expressed the gratitude of the Institution as a whole for the interest which Sir Alfred Herbert had taken in the affairs of the Institution during the two years that he had been President and made special reference to the fact that Sir Herbert had travelled nearly 200 miles to be present at the first Meeting of the Birmingham Section. The members also had every reason to be grateful to the work that had been done by Mr. Hutchinson as Chairman of the Council over a long period of years, for he had set an example which they all ought to try to live up to in helping each other in every possible way.

The General Secretary had suggested that he should give a brief report of the past year's work. The first thing he had to say in that connection was that the Institution was now in an established position and able to do something really useful for its members if only the members themselves would take their share in that work. The position now was very different from what it had been a few years ago. For some time the Institution had suffered in not having a permanent full-time Secretary, and there had been some hesitation in incurring the expense necessary to make this change. Eventually, it was decided that the only way to make the Institution really effective to carry out the aims and objects for which it had been originally started was to have a full-time Secretary, and after very careful consideration by a Sub-Committee of the 172 applications that were received, Mr. Hazleton was appointed, and so, at last, the Institution had its own offices and its own full-time Secretary.

Continuing, the Chairman said that when he was first introduced to the Institution he did not know a lot about it but the more he had learned about the Institution the more he was convinced that it was a necessity. If institutions such as the Institution of

Mechanical Engineers, the Institution of Electrical Engineers, and the Institution of Automobile Engineers were justified, then he contended that the Institution of Production Engineers was more than justified having regard to the developments in engineering work to-day, if our country was to maintain the leading position that it had held in years gone by. Personally, he had unlimited faith that engineers, and particularly the young engineers, would be the salvation of our country. Everything nowadays depended on engineering, and it was to the production engineers that a great deal of future development work would fall.

Although the General Secretary had only been appointed a few months, the Journal was now beginning to go ahead. Their President-elect was Mr. Tom Thornycroft, under whose guidance there was little doubt that the Institution would continue to progress. There was a strong Council containing many well known engineers including, he was pleased to say, some of the founder members. For instance, it was pleasing to see Mr. Scaife taking an interest again in the affairs of the Institution, whilst Sir Alfred Herbert also remained on the Council. The Finance and Development Committee was presided over by Mr. Hutchinson, whilst the Examinations Committee had Mr. Mantell as its Chairman.

When the Birmingham Section was opened by Mr. Engelbach he suggested that the Council should consider some scheme of education and that recommendations should be made to the various Universities with the object of providing facilities for training in production engineering. Eventually, a Committee was formed, and the endeavour was now being made to thrash out some sort of scheme. A stage had been reached at which the Associations of Teachers in Technical Institutions had agreed to help and the matter was to be discussed in the very near future with the Institution. During the three or four months that this matter had been under consideration at least half a dozen different technical institutions or schools had written asking what the Institution was doing and seeking information.

The Institution needed more members, but it required real members. A great deal of the time of the Council Meetings was spent in considering applications in order to ensure that only really suitable people should be admitted, and every endeavour was being made to get the right type of man. Another matter in connection with membership was the section of Affiliated Firms, who paid £5 per annum for the privilege of appointing a representative. Already in the Midlands there were seven Affiliated Firms. One of them nominated two members to attend Meetings of the Institution and he urged as many firms as possible to support the Institution by joining in this way and appointing one or more members of their staff to come to the Institution Meetings, and report back to their firms the information they received there

He had been talking this over with the managing director of a large firm in Birmingham, and when the matter was put to him in this way he jumped at the suggestion and said that that was exactly what he wanted.

There had been several discussions regarding the formation of new Sections, and Members of the Council considered that a Section should be formed in Manchester. He hoped that by January matters would be sufficiently advanced to form a Section there. It had also been suggested by certain members that a Section should be formed in Luton, and that matter was to be considered immediately.

MR. R. H. HUTCHINSON proposed a vote of thanks to Sir Alfred Herbert for his services as President for the past two years. Having been one of the founder members himself he felt he could in a measure speak for the work that Sir Alfred Herbert had done. In the early days the Institution had a fairly rough passage and it was the founder members perhaps, or at any rate, the older members, who were able to appreciate more what Sir Alfred Herbert had done than the newer and young members. One of the most valuable directions in which Sir Alfred Herbert had assisted was the manner in which he would always talk about the work of the Institution and get other people interested in it. Sir Alfred had probably influenced as many members into the ranks of the Institution as the keenest of any of the Members of Council, and the value of the work he had done could not be over-estimated. One of the things Sir Alfred did was to offer a prize for the best paper on the electric driving of machine tools. Personally, he felt that the question of the Institution offering a prize for a paper on a different subject each year should be fostered, and that the members should be encouraged to write papers. He would like Sir Alfred Herbert to be able to look back in years to come and see the fruits of the work he had done for the Institution, and it was for this reason that he proposed a hearty vote of thanks to him.

MR. G. H. HALES, seconding the vote of thanks, referred to the struggles of the Institution in its early days, and to the manner in which Sir Alfred Herbert had given a hall-mark to the Institution in that the work he had done for it had attracted many eminent and highly-placed engineers into the membership of the Institution who, in the first place, had held back until the Institution had to some extent proved itself. It was the fact that production engineers throughout the country were now beginning to realise that there was something in the Institution, and if they only took advantage of the help given by Sir Alfred Herbert they would go ahead and be considerably stronger than they had been in the past.

The vote of thanks was carried with acclamation.

THE CHAIRMAN then introduced Mr. Tom Thornycroft, the new President for 1929-30, who was given a very cordial reception.

The President's Address.

MR. TOM THORNYCROFT, after expressing his thanks for the manner in which he had been received and the honour that he had been done in being elected President of the Institution, regretted that he had been unable, owing to extreme pressure of business, to prepare anything definite in the way of a Presidential Address and therefore he proposed to have what might be regarded as an informal chat on his ideas of production, after which he would be pleased for anybody to criticise and discuss what he had said.

He had always felt that production engineers do not have a fair show, and he would be pleased to do anything in his power to help production engineers in general and the Institution in particular. He had been interested in what Mr. Hutchinson had said with regard to the offer of a prize by Sir Alfred Herbert, and he on his part would be very pleased to offer a similar prize for a paper on some subject which could be decided upon later. He was very pleased that a permanent Secretary had been appointed, because without such an official the work of any institution could not be carried on effectively and efficiently. Indeed, even in the short time that Mr. Hazleton had been at work the Institution had made great strides. Speaking of production engineering, the President said that the idea of production engineering was nearly always associated with America, but although the term "production engineering" came first from America he thought that we in this country could claim that we were the first production engineers in the world. Although he was speaking without the book, he imagined that mass production—a horrible American term—was first applied to textile machinery. As to what the production engineer's job really was, it was a little difficult to say, because he was always the man who was come down upon if the proper result was not obtained. His job, of course, was to produce what was required in the most efficient manner. The production engineer's job, however, was an extremely difficult one, as was shown by the fact that in one of the best foundries in the country which he had recently visited, those concerned mostly disagreed as to the correct mixture to make a modern motor car cylinder. One of the difficulties facing the production engineer was that in many factories they had far too many materials. He was in one works three or four years ago in the Coventry district, and in discussing the difficulty of getting correct heat treatment asked one of the men there how many steel specifications he was working to and was told that there were probably about 100. How was it possible to expect to get 100 steels correctly heat-treated? Personally, he felt that ten steels going through any works was sufficient and even then it was possible to get rotten material. This was one of the directions in which production engineers ought to work together as much as

possible. There should only be, say, two gear steels, a few steels for tools, and only a very few special steels. This would save an immense amount of money in production, and ought to be possible nowadays when every works of any size had its own chemist. When he was a boy the works chemist had not been heard of, and he felt that they ought to get down to something like five steels in any works. Incidentally, in America in the large engineering works where such wonderful production took place it was mostly Britishers who were the leading production engineers.

Referring to education, the President said he was a great believer in a reasonable amount of technical education on the part of everybody. Even the man who worked a quite simple machine should have as much technical education as possible, because then he would know probably why he was doing his particular job in a particular kind of steel and why that material could be fed into his machine more quickly than if another type of steel was used. That amount of knowledge made a man keener. Indeed, he felt everybody was keener if he knew the reason why he was doing things, and it developed enthusiasm from the bottom to the top. Whilst there was enthusiasm there would be keenness, and nobody did their work efficiently unless they were really keen.

Another point of interest in connection with production engineering was the argument that it was essential to have the very latest machine for a particular job. That, however, depended entirely on the number of articles that had to be turned out. This was brought to his notice a few weeks ago by one of his people who wanted a new milling machine because certain parts were being made of aluminium instead of cast iron and the suggestion was that if a new machine was obtained the parts could be turned out at a much quicker rate. When he inquired as to the number of parts that were being made he was told that it was fifteen a month, and he at once replied that it was useless to have a new machine to do work that would keep it occupied only for about three days in the month. When overheads and the labour were worked out it was found that the work could be done just as efficiently and more cheaply by continuing with the old machine. That might sound retrograde, but from several instances that had come before him it had been proved that a large expenditure on new machines was only justified when a large number of parts were to be made. He had been most impressed when visiting the works of the Birmingham Aluminium Company, where there were some pressure die casting machines running by compressed air which were turning out over 10,000 of a particular article per annum, but it would be stupid to put in such a machine when only a few of these articles were required during the year. Therefore, the nature of the job must be taken into account when considering the installation of new machine tools. An example of this had come before his notice during the

war when under the Government costing scheme 3s. 6d. was paid for a brass bush which had only cost his firm 8d. to make, and the Government Inspector said it was utterly impossible for them to be made at the price. His firm, therefore, was paid 3s. 6d. for an article that they could have sold for 8d., and it was all a question of suitably arranging the machine tools for the particular job.

Another item of importance to the production engineer was that very often an old machine could be adapted to a special purposes machine when there was a big enough number of articles to be made. An example of that also came to his notice during the war, in connection with 18-pounder shells. It was a case of a man who had a jobbing shop and who was actually able to turn out for 7s. 6d. what the Government Inspectors, under their costing scheme, said should be 25s. The owner of this shop actually turned out a large number of 18-pounder shells at 7s. 6d., for which he was paid 25s., and made an enormous amount of profit.

In conclusion, the President said that he would do his very best to further the interests of the Institution and assist the production engineer in obtaining his proper status. In the old days things were never made until people wanted them made. Then came the phase when the selling department was introduced, and the selling department had rather become the top dog, but it was essential for all departments in every firm to pull together, the selling man, the financial man, and the production man, because unless that was the case the best results could not be hoped for.

Discussion.

Mr. W. G. Groocock (President, Birmingham Section), speaking of the point mentioned by the President as to the need for the Institution said that it was undoubtedly necessary because no other institution catered for the needs of the production engineer. There was just a fear in his mind that the Institution had been a little too close in the past in its definition of a production engineer and he rather felt that it should be widened. As to which nation introduced production engineering it was true that the first mass production of machinery was in the textile trade, as mentioned by the President, but he believed it was also true that the first mass production in the engineering sense was for war purposes, for rifles and pistols in America during the Civil War, and that gave us what was so useful to-day, namely, interchangeability. That was probably the first time that interchangeability was applied in any magnitude to production. As regards materials, there was one material that had not received too much attention hitherto, and that was the human material, which required more study than any other, and there was no better side for the production engineer to study than the human side. In endeavouring to get greater production from the individual workman or machine he did not

mean that it was necessary to pay a higher rate of wages per hour. It did not follow at all that rates should be increased, and, as a matter of fact, he disliked the term "rate of pay" because it did not mean anything to-day. What they should get firmly fixed in their minds was the unit rate under which the more work a man did the more pay he got. He felt that in many of the wage systems adopted the principle that as the output got larger the rate per unit decreased was all wrong, and the sooner there was general agreement on the principle that as the effort increased the reward should be larger the sooner we should get to the ideal system of payment. As regards enthusiasm and education, if he had to choose between the man who was enthusiastic without education and the man who had education without enthusiasm, he would choose the enthusiastic man, although in doing so he did not wish to be regarded as casting a slur on education. With regard to the civil war that usually existed between the financial, the sales, and the production sides, the production engineer was usually the buffer, and there was a great deal of force in what the President had said as to the necessity for all departments working in co-operation.

MR. I. H. WRIGHT (Hon. Secretary, Birmingham Section), speaking with regard to qualifications for membership of the Institution and the need for very careful selection of members, said the Institution began largely amongst automobile engineers. His view, however, was that the manufacturers of any class of goods, if they were using engineering methods, should come into the Institution; even if they were makers of pots and pans, of which so many were in existence in the Birmingham area. Among the Birmingham industries there were many production problems, transport problems, and problems relating to the quality of materials, etc., which were common to all mass-production businesses, and these people should be encouraged to join and to discuss their problems at Meetings of the Institution. Personally, he was a machine tool man and not a production engineer, so that he spoke rather from outside, but he believed that the production engineer was not always as willing and anxious as people in these other trades to discuss all these problems. It seemed to him that production engineers should be more ready to discuss their problems than was very often the case at the present time. There was an attitude of mind that a problem should not be talked about until it had been solved, but by that time other things had come along and there was no time to talk about it. Therefore, the production engineer should be more ready to discuss problems as they were being dealt with because only in that way could they help each other. This criticism, however, did not apply only to the production engineer because attention had been drawn to it by Mr. Daniel Adamson, in his Presidential Address to the Institution of Mechanical Engineers.

MR. GERARD SMITH recalled the fact that the first Meeting that was held before the Institution started dealt with nothing else than the scope of the membership, but the general opinion then was that a production engineer was a man who made metal articles only. That had left a mark on the psychology of the Institution, but he was glad that they were now discussing the widening of the scope of membership and a widening of the definition of a production engineer. As an instance of what other firms than purely engineering firms could teach them in production, there was the Beddow system of measuring work. There were very few engineering firms who had adopted this, but there were firms in other industries who used it and could give a good deal of information about it. A great deal could be learned from such firms in matters of organisation, and he would like to see a section of the membership specially reserved for discussing methods of organisation, men who, perhaps, did not know the difference between steel and brass, because the works engineer of to-day was becoming a business man and organiser, and it was just as important that the Institution should get into its membership the big organisers of industry as it was to have the men who actually made automobiles.

MR. STOTSBURG remarked that he knew of two firms who had introduced the Beddow system, but both had thrown it out because it had not been a success.

MR. R. H. HUTCHINSON expressed agreement with the view that it does not matter what a man is producing ; so long as he is producing it by engineering means and scientific organisation he should be eligible for membership of the Institution. He did not altogether agree with the President's remarks with regard to retaining old machine tools except to the extent that an old tool could often be put into a corner of the shop and kept there for a particular job. That was often done and it was frequently found that an old tool could do the particular job at a reasonable cost. With regard to the new milling machine that was asked for but refused by the President, although at first it might have only been required for a few articles per month, it would not have been long before the demands on that machine would have considerably increased. That, at any rate, was his experience. A case in point was that some time ago, in a works where he was engaged, a centreless grinder was put in for grinding gudgeon pins. At first the centreless grinder was only found work for three days a month, but it was not long before the foreman of the section found many other jobs for that grinder, and eventually it was kept fully occupied, although at first it appeared that there would only be three days' work a month for it.

MR. GARTSIDE expressed the view that the expression, " production engineer," was having the effect of keeping out many people who were really eligible for membership, people who were in control

of different operations. A great deal could be learned from the sausage maker, the biscuit maker, or the tin pot maker, who were all engaged on production, and as one who had to go about among many different works he was frequently obtaining useful ideas which were of value to him as a maker of special machines.

MR. G. H. HALES also referred to the early discussions as to the definition of a production engineer, but the President had given a lead in favour of widening the ideas that were held on this matter in the early days. The difficulty with regard to the number of material specifications, mentioned by the President, had been felt by most people for many years. The fault to some extent was due to our Government Departments because the craze for materials specifications that started during the war seemed to have persisted ever since. For instance, in connection with motor lorries, the Government specifications required three or four distinct lorries, although in essentials they were really the same. With regard to installing up-to-date machine tools, he was afraid that there were not many firms who would take the risk that Mr. Hutchinson had in the case of his centreless grinder. The line must be drawn somewhere, and, personally, he would not care to instal a machine in those circumstances, unless it was certain to be occupied for 20 per cent of its time. Some people took the view that 60 per cent of the total capacity of such a machine should be fully occupied before its installation could be regarded as justified. With regard to installing machines to do many and varied operations, some recent information from America indicated that a new trend of development there was to discontinue the practice of adopting single purpose machines and to instal machines of greater utility so that they could more easily deal with changes of design when they came about.

THE PRESIDENT having expressed his appreciation of the manner in which his Address had been discussed, a hearty vote of thanks was passed to him, and the Meeting closed.